

Notice of Allowability

Application No.

10/810,733

Examiner

Jae W. Lee

Applicant(s)

CHENG ET AL.

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 02/08/2007.
2. ☒ The allowed claim(s) is/are 1,2,7,14-17,19,21,22,26,27 and 34-37.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date 01/29/2007
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____

DETAILED ACTION

Election/Restrictions

The Examiner is hereby withdrawing the Restriction requirement between SEQ ID NO: 20 and each of the individual SEQ ID NOs: 2, 4, 6, 8, 10, 12 and 14, in the Office Action dated 08/30/2006.

Election

During a telephone conversation with Mr. Neil Feltham on 04/23/2007, a provisional election of SEQ ID NO: 2 was made without traverse.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Neil Feltham on 04/23/2007.

The application has been amended as follows:

The title should be changed to: "GENES OF STRAIN DC413 ENCODING ENZYMES INVOLVED IN BIOSYNTHESIS OF CAROTENOID COMPOUNDS"

- Claim 1 An isolated nucleic acid molecule selected from the group consisting of:
- (a) an isolated nucleic acid molecule encoding the amino acid sequence of
SEQ ID NO: 2;
 - (b) an isolated nucleic acid molecule that hybridizes with (a) under the
following hybridization conditions: 0.1 X SSC, 0.1% SDS, 65°C and
washed with 2X SSC, 0.1% SDS followed by 0.1X SSC, 0.1% SDS;
and
 - (c) an isolated nucleic acid molecule that is complementary to the full-
length of (a) or (b),
- wherein said isolated nucleic acid molecule of (a) and (b) encodes a
geranylgeranyl pyrophosphate synthetase enzyme.
- Claim 2 The isolated nucleic acid molecule of Claim 1, comprising SEQ ID NO: 1.
- Claim 3 (Canceled)
- Claim 4 (Canceled)
- Claim 5 (Canceled)
- Claim 6 (Canceled)
- Claim 7 An isolated nucleic acid molecule comprising a first nucleotide sequence
encoding a geranylgeranyl pyrophosphate synthetase enzyme of at least
302 amino acids that has at least 95% sequence identity, based on the
Smith-Waterman method of alignment, when compared to a polypeptide

having the sequence as set forth in SEQ ID NO: 2; or a second nucleotide sequence comprising the complement of the full-length of the first nucleotide sequence.

Claim 8 (Canceled)

Claim 9 (Canceled)

Claim 10 (Canceled)

Claim 11 (Canceled)

Claim 12 (Canceled)

Claim 13 (Canceled)

Claim 14 A chimeric gene comprising the isolated nucleic acid molecule of Claim 1 or 7, operably linked to suitable regulatory sequences.

Claim 15 A vector comprising the isolated nucleic acid molecule of Claim 7 or 37.

Claim 16 An isolated transformed host cell comprising the chimeric gene of Claim 14.

Claim 17 An isolated transformed host cell comprising the isolated nucleic acid molecule of Claim 7 or 37, wherein the host cell is selected from the group consisting of bacteria, yeast, filamentous fungi and algae.

Claim 18 (Canceled)

Claim 19 The transformed host cell of Claim 17 wherein the host cell is selected from the group consisting of *Aspergillus*, *Trichoderma*, *Saccharomyces*, *Pichia*, *Candida*, *Hansenula*, *Yarrowia*, *Rhodospiridium*, *Lipomyces*, *Salmonella*, *Bacillus*, *Acinetobacter*, *Zymomonas*, *Agrobacterium*,

Flavobacterium, Rhodobacter, Rhodococcus, Streptomyces, Brevibacterium, Corynebacteria, Mycobacterium, Escherichia, Pantoea, Pseudomonas, Methylomonas, Methylobacter, Methylococcus, Methylosinus, Methylochromium, Methylocystis, Alcaligenes, Synechocystis, Synechococcus, Anabaena, Thiobacillus, Methanobacterium, Klebsiella, Methylophilus, Methylobacillus, Methylobacterium, Hyphomicrobium, Xanthobacter, Paracoccus, Nocardia, Arthrobacter, Rhodopseudomonas, Torulopsis, Phaffia, and Rhodotorula.

Claim 20 (Canceled)

Claim 21 A method for the production of carotenoid compounds comprising:

(a) providing a transformed host cell comprising:

(i) suitable levels of farnesyl pyrophosphate; and

(ii) the isolated nucleic acid molecule of Claim 7 or 37 under the control of suitable regulatory sequences;

(b) contacting the host cell of step (a) under suitable growth conditions with an effective amount of a fermentable carbon substrate whereby carotenoid compounds are produced.

Claim 22 A method according to Claim 21 wherein the transformed host cell is selected from the group consisting of bacteria, yeast, filamentous fungi, and algae.

Claim 23 (Canceled)

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Claim 24 (Canceled)

Claim 25 (Canceled)

Claim 26 A method according to Claim 21 wherein the transformed host cell is selected from the group consisting of *Aspergillus*, *Trichoderma*, *Saccharomyces*, *Pichia*, *Candida*, *Hansenula*, *Yarrowia*, *Rhodospiridium*, *Lipomyces*, *Salmonella*, *Bacillus*, *Acinetobacter*, *Zymomonas*, *Agrobacterium*, *Flavobacterium*, *Rhodobacter*, *Rhodococcus*, *Streptomyces*, *Brevibacterium*, *Corynebacteria*, *Mycobacterium*, *Escherichia*, *Pantoea*, *Pseudomonas*, *Methylomonas*, *Methylobacter*, *Methylococcus*, *Methylosinus*, *Methylomicrobium*, *Methylocystis*, *Alcaligenes*, *Synechocystis*, *Synechococcus*, *Anabaena*, *Thiobacillus*, *Methanobacterium*, *Klebsiella*, *Methylophilus*, *Methylobacillus*, *Methylobacterium*, *Hyphomicrobium*, *Xanthobacter*, *Paracoccus*, *Nocardia*, *Arthrobacter*, *Rhodopseudomonas*, *Torulopsis*, *Phaffia*, and *Rhodotorula*.

Claim 27 A method according to Claim 21, wherein the carotenoid compound produced is selected from the group consisting of *antheraxanthin*, *adonirubin*, *adonixanthin*, *astaxanthin*, *canthaxanthin*, *capsorubin*, β -*cryptoxanthin*, α -*carotene*, β -*carotene*, *epsilon-carotene*, *echinenone*, *3-hydroxyechinenone*, *3'-hydroxyechinenone*, γ -*carotene*, *4-keto- γ -carotene*, ζ -*carotene*, α -*cryptoxanthin*, *deoxyflexixanthin*, *diatoxanthin*, *7,8-didehydroastaxanthin*, *fucoxanthin*, *fucoxanthinol*, *isorenieratene*,

lactucaxanthin, lutein, lycopene, myxobactone, neoxanthin, neurosporene, hydroxyneurosporene, peridinin, phytoene, rhodopin, rhodopin glucoside, 4-keto-rubixanthin, siphonaxanthin, spheroidene, spheroidenone, spirilloxanthin, 4-keto-torulene, 3-hydroxy-4-keto-torulene, uriolide, uriolide acetate, violaxanthin, zeaxanthin- β -diglucoside, and zeaxanthin.

Claim 28 (Canceled)

Claim 29 (Canceled)

Claim 30 (Canceled)

Claim 31 (Canceled)

Claim 32 (Canceled)

Claim 33 (Canceled)

Claim 34 An isolated nucleic acid molecule encoding all of the amino acid sequences as set forth in SEQ ID NO: 2, 4, 6, 8, 10, 12 and 14.

Claim 35 (Canceled)

Claim 36 An isolated nucleic acid molecule having the nucleic acid sequence as set forth in SEQ ID NO: 20.

Claim 37 An isolated nucleic acid molecule having at least 95% sequence identity to SEQ ID NO: 20 and encoding all of the following enzymes:

(a) geranylgeranyl pyrophosphate synthetase having the amino acid sequence as set forth in SEQ ID NO: 2;

(b) zeaxanthin glucosyl transferase having the amino acid sequence as set forth in SEQ ID NO: 4;

- (c) lycopene cyclase having the amino acid sequence as set forth in SEQ ID NO: 6;
- (d) phytoene desaturase having the amino acid sequence as set forth in SEQ ID NO: 8;
- (e) phytoene synthase having the amino acid sequence as set forth in SEQ ID NO: 10;
- (f) β -carotene hydroxylase having the amino acid sequence as set forth in SEQ ID NO: 12; and
- (g) isopentenyl diphosphate isomerase having the amino acid sequence as set forth in SEQ ID NO: 14.

The following is an examiner's statement of reasons for allowance:

The art does not teach or suggest an isolated nucleic acid molecule encoding the amino acid sequence of SEQ ID NOs: 2 or 20, which are related to a genomic gene cluster of *Enterobacteriaceae* DC413 isolated from Florida soil sample that are specifically useful in the biosynthesis of carotenoid compounds. The Examiner also notes that the closest prior art was WO2002/079395, which teaches a genomic gene cluster for the biosynthesis of carotenoid compounds in *P. stewartii*. The Examiner further notes a reference, Sedkova et al. (Diversity of carotenoid synthesis gene clusters from environmental *Enterobacteriaceae* strains, *Applied and Environmental Microbiology*, 2005, pg. 8141-8146), which teaches the percent sequence homologies

of different genes involved in the biosynthesis of carotenoid compounds from different bacterial strains. This is useful in understanding differences between gene clusters involved in the biosynthesis of carotenoid compounds and how they are related to one another.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

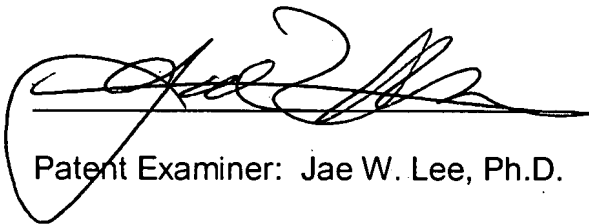
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jae W. Lee whose telephone number is 571-272-9949. The examiner can normally be reached on 8:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kathleen K. Bragdon can be reached on 571-272-0931. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

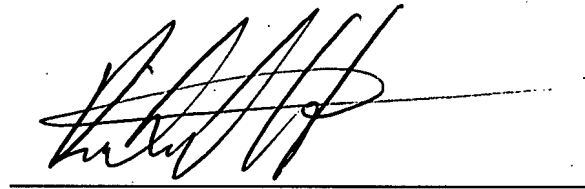
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

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Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Patent Examiner: Jae W. Lee, Ph.D.



RICHARD HUTSON, PH.D.
PRIMARY EXAMINER